

Excision of Painful Bipartite Patella

Good Long-term Outcome in Young Adults

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Abstract Excision of the accessory bipartite fragment is widely used, but its long-term outcome is not known. We evaluated the outcome after surgical excision of a symptomatic accessory bipartite or multipartite patella fragment in young adult men performing their compulsory military service and determined the incidence of painful bipartite patellae in this group of skeletally mature adults. We followed 25 of 32 patients for a minimum of 10 years (mean, 15 years; range, 10–22 years). The incidence of painful, surgically treated bipartite patella was 9.2 per 100,000 recruits. Patients' median age at surgery was 20 years. There were 19 superolateral and six lateral bipartite fragments. Other radiographic findings were rare. At followup, the Kujala score mean was 95 points (range, 75–100 points), and osteoarthrotic changes (Kellgren-Lawrence Grade 1) were seen in two knees. No reoperations related to

bipartite patella occurred during the followup. Symptomatic bipartite patella is rare and does not seem primarily associated with anatomic deviations, but when incapacitating pain persists despite nonoperative treatment, surgical excision seems to yield reasonable functional outcome and quick recovery with no apparent adverse sequelae. Our data suggest there is no reason to avoid this technically demanding procedure for treating persistent symptoms of bipartite patella in young adults.

Level of Evidence: Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

The bipartite patella was first described by Gruber [10] in 1883, and much has been added to our knowledge of this chondroosseous disruption of the patella since then [8, 15, 24, 25, 28, 29]. A bipartite or multipartite patella is estimated to have a prevalence of 0.2% to 6% in an adult population [9, 15, 28]. Most bipartite patellae are asymptomatic [30] and a clinically irrelevant anatomic variant [9, 13, 28]. The partition is considered the result of an accessory ossification center failing to fuse with the primary patella during adolescence [2, 8, 10, 24], but alternative explanations have been offered such as trauma and nonunion [7, 26], tendinous traction [22, 26, 28, 29], vascular insufficiency [26], or some combination [5].

One report suggests fewer than 2% of bipartite patellae are symptomatic [30]. When the bipartite patella does become painful, it usually presents either with a gradual onset of symptoms during activity or with a more sudden onset of symptoms after injury to the knee [23, 26, 28]. Gradual onset of symptoms often is related to continuous

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strenuous exercise, implying repetitive microtrauma, and typically is seen in athletes [30] and soldiers [28]. Most patients with a painful bipartite patella are reportedly adolescent or young adult males, although no anatomic or other reason has been noted in these reports to explain the male dominance [1, 5, 21, 22, 30]. A more recent study included patients up to 68 years of age [15]. The condition reportedly is bilateral in as much as 43% to 50% of patients [6, 9], and the proportion of bilaterality tends to be smaller when symptoms arise after injury [27].

The choice of treatment for painful bipartite patella depends on the case history. Initial treatment is nonoperative, consisting of restriction of activity or temporary immobilization, which relieves the symptoms in most cases. Nonoperative treatment is preferred, especially for adolescent patients and patients with a more gradual onset of symptoms [23]. When nonoperative treatment fails, surgery reportedly provides good relief from symptoms, even after a duration of symptoms of up to 11 years [13]. In cases of acute and sudden pain, often trauma-related, surgery is preferred by some [13, 30] and one study suggests it relieves symptoms [13]. For treating larger fragments, or fragments with little mobility, diverse surgical techniques aimed at decreasing traction on the fragment have been developed during the last decade [1, 21, 22], and in some cases with large lateral fragments, internal fixation has been used [6, 14]. Excision of the accessory bipartite fragment has remained the most widely used surgical method of treatment [1, 3, 21], especially in skeletally mature patients. Elimination of symptoms after excision has been reported in 0.5- to 5-year followups among

adolescents [9, 14, 22, 23, 30] and adults [13]. One study reports complete pain relief in long-term followup after excision for 13 of 16 skeletally immature adolescents [5]. However, long-term results of excision of an accessory bipartite fragment would be of importance for orthopaedic surgeons treating skeletally mature patients with symptomatic bipartite patellae.

The aims of this study were: (1) to determine the incidence of painful bipartite patella in young adult males performing their military service; (2) to evaluate the long-term outcome after surgical excision of a symptomatic bipartite patella in this group of skeletally mature adults; and (3) to radiographically evaluate possible anatomic deviations associated with a symptomatic bipartite patella.

Materials and Methods

We retrospectively reviewed the medical records of all 32 military recruits with painful bipartite or multipartite patellae who underwent excision of a superolateral (Fig. 1) or lateral (Fig. 2) patellar fragment between January 1, 1985, and December 31, 1995, and all these patients were invited for long-term followups. The operations were performed at the authors' institution, which provided all surgical services for the entire armed forces of the country at that time. All male citizens in Finland become liable for compulsory military service when they reach 18 years of age; the majority of the recruits are 19 years old at the beginning of their basic training. The 349,054 recruits who performed their compulsory military service between 1985

Fig. 1A–B An 18-year-old recruit (Patient 24) presented with patellar pain during exercise. (A) The preoperative anteroposterior radiograph of the right knee shows a superolateral bipartite patellar fragment (arrow). (B) At final followup 14 years later, the patient had an excellent functional outcome. The postoperative anteroposterior radiograph of the operated knee shows the site of excision (arrow).

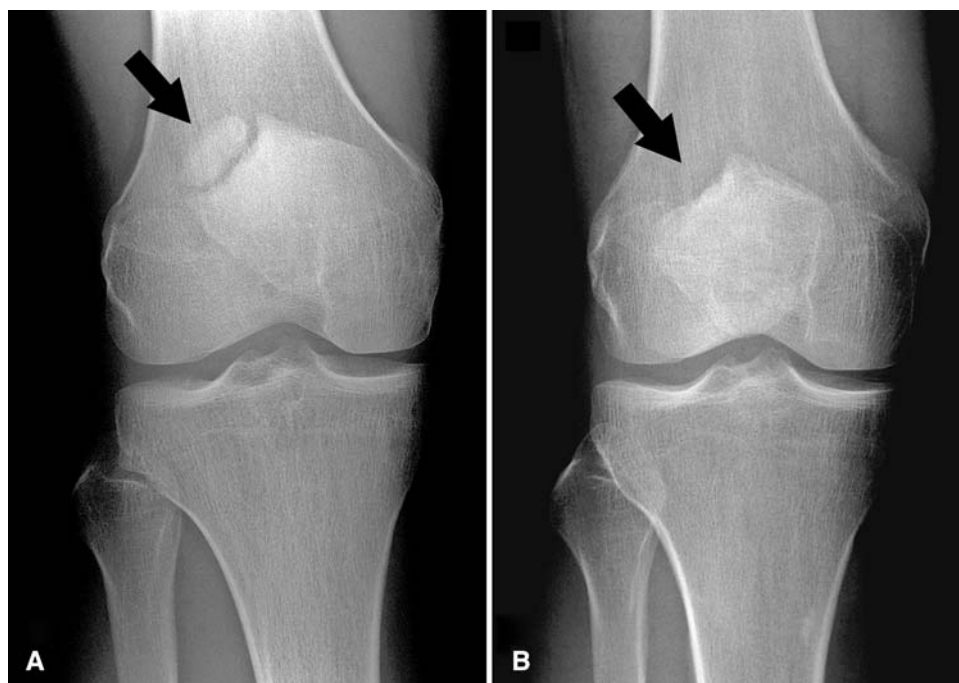
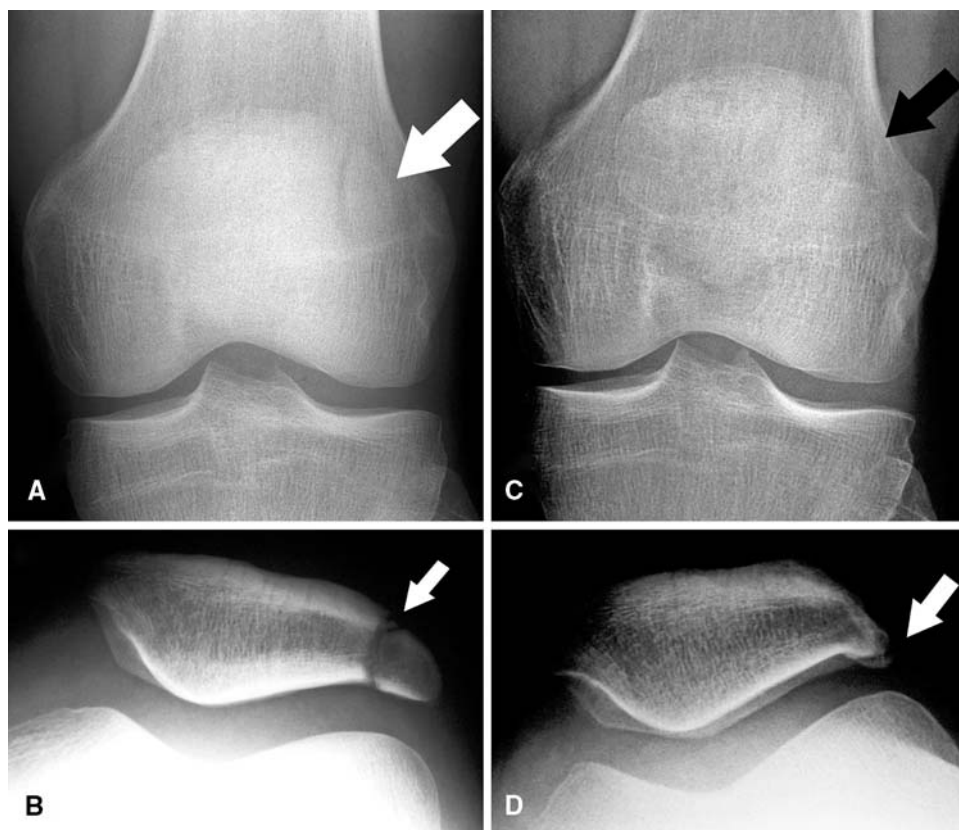


Fig. 2A–D A 22-year-old recruit (Patient 22) first presented with hemarthrosis after a contusion to the knee. At arthroscopy, a lateral bipartite fragment was detected, and as symptoms continued, the fragment was removed 4 months later. The lateral bipartite patellar fragment (arrow) of the left knee was visible on the preoperative (A) anteroposterior and (B) tunnel view radiographs. At final followup 14 years later, the patient had an excellent functional outcome, and the site of excision was not conspicuous on (C) anteroposterior and (D) tunnel view radiographs.



and 1995 formed the population at risk, and we used this total number of recruits to calculate the incidence of patients with painful bipartite patella undergoing surgical treatment during this 11-year period. The study was approved by the medical ethics committee of our institution, and we obtained informed consent from each patient.

All patients had passed the medical examination required before entering the military service: all were healthy and none had known disease or were receiving medication. The median age at the time of surgery was 20 years (range, 18–27 years), mean height was 177 cm (range, 168–189 cm), and mean weight was 73 kg (range, 59–89 kg). Body mass index (BMI) at the time of surgery was calculated as weight (in kilograms) divided by height (in meters squared; kg/m^2), and for an adult male younger than 30 years, we considered the 18.5 to 24.9 kg/m^2 BMI range normal [19, 32]. The average BMI was 23.2 kg/m^2 (range, 19.7–28.4 kg/m^2). Four patients were slightly overweight (BMI, 25.0–29.9 kg/m^2). There were 13 right and 12 left knees operated on, and all patients were young adult males (Table 1). Previous excision of a superolateral painful bipartite fragment had been performed 7.5 years earlier at another institution in one patient, who during military service again presented with a painful bipartite fragment at the same superolateral part of the patella. One patient had previous surgery for osteochondritis dissecans

that had healed well and was not visible on MR images taken before excision of the painful bipartite fragment. One patient had undergone patellar medialization 5 years before excision of the painful bipartite fragment.

Median duration of symptoms before excision was 11 months (range, 3–144 months). Twenty-three patients reported pain during exercise (marching), including two patients who also reported pain at rest or when kneeling. Two patients reported pain associated with kneeling only. Twenty-four patients were active in some kind of recreational sport before surgery. One-third of the patients reported the onset of symptoms after an injury to the knee.

We requested all patients return for a long-term followup examination. Five of the 32 patients were lost to followup. Of these five patients, four were deceased according to the official registries, and one patient could not be located. Of the 27 patients we operated on who were available for followup, two were excluded because of extensive subsequent knee surgery unrelated to the bipartite patella. One of these patients underwent four operations on the left and six operations on the right knee after having injured both knees in a traffic accident and has, despite continuous knee pain, recently returned to work. The other patient injured his knee twice playing basketball and persistent posttraumatic synovitis and a meniscal tear developed for which he underwent arthroscopy, open

Table 1. Details for 25 patients treated with excision of a painful bipartite patellar fragment

Patient number	Age at surgery (years)	Gender	Side	Fragment location	Symptom duration before surgery (months)	Followup (years)	Functional outcome score*
1	20	M	R	Lateral	6	13	96
2	23	M	R	Lateral	36	13	98
3	20	M	L	Lateral	24	15	89
4	19	M	L	Lateral	120	14	100
5	23	M	L	Superolateral	8	13	100
6	20	M	R	Superolateral	5	17	92
7	20	M	R	Superolateral	48	10	96
8	19	M	L	Superolateral	24	12	94
9	22	M	R	Superolateral	7	18	100
10	20	M	L	Superolateral	3	18	100
11	20	M	L	Superolateral	24	12	89
12	27	M	L	Superolateral	11	12	89
13	27	M	R	Superolateral	144	14	98
14	20	M	L	Superolateral	8	18	89
15	20	M	L	Superolateral	12	12	95
16 ^a	20	M	R	Superolateral	4	16	98
17 ^b	20	M	R	Superolateral	60	18	92
18	20	M	R	Superolateral	6	12	94
19 ^c	19	M	R	Lateral	5	15	98
20	20	M	L	Superolateral	48	22	75
21	20	M	L	Superolateral	4	17	94
22	22	M	L	Lateral	4	14	96
23	20	M	R	Superolateral	12	18	100
24	18	M	R	Superolateral	96	14	96
25 ^d	20	M	R	Superolateral	3	17	100

* Kujala score [17, 31]: excellent = 95 points or more, good = 94 to 85 points, fair = 84 to 65 points, poor = less than 65 points; M = male; F = female; R = right; L = left; a = subsequent reconstruction of the anterior cruciate ligament; b = subsequent arthroscopic revision of patellar chondromalacia; c = arthroscopic removal of the accessory bipartite fragment; d = lateral retinacular release.

partial synovectomy, and arthroscopic partial meniscectomy. Altogether, 25 patients with 25 surgically treated symptomatic bipartite fragments participated in the final followup. The minimum followup was 10 years (mean, 15 years; range, 10–22 years).

The initial treatment for all patients with a symptomatic bipartite or multipartite patella was nonoperative, consisting mainly of restriction of activities or rest and nonsteroidal antiinflammatory drugs when necessary. Surgery was the chosen treatment when the response to nonoperative treatment was insufficient and when prolonged, incapacitating pain persisted. The method we used was excision of the smaller bipartite fragment. During the study period it was performed by six orthopaedic surgeons (OK, PJ, TV, KH, V-MN, KT) using the same approach and technique. We first performed arthroscopy to rule out other internal derangement of the knee. We observed patellar chondromalacia (Grade 1) in two knees, neither of

which had any specific treatment. Likewise, a synovial plica was seen in two knees, but neither had resection. In 10 of the 21 knees that underwent arthroscopic examination, we saw a narrow line of indentation between the fragments, or prominence of the smaller fragment. In addition, there were slight chondromalacia-like changes on the articular surface of the fragment in 10 knees. We removed the bipartite fragment in 24 patients by subperiosteal excision performed through a separate longitudinal incision made over the unfused fragment. The accessory fragment was dissected free from surrounding ligamentous and fibrous tissue and removed. The cavity of the removed fragment was closed from medial to lateral with absorbable sutures and the skin incision was closed with nonabsorbable sutures. In one patient, we performed the removal arthroscopically (Table 1, Patient 19). Two knees had three loose fragments that were removed from the superolateral site. We performed lateral retinacular release in one patient

who, on preoperative radiographs, had lateralization of the patella (Table 1, Patient 25), and one patient underwent partial meniscus resection. In one patient, excision of the bipartite fragment was performed on the right knee, and at the same time, revision of medial and distal patellar chondromalacia was performed on the contralateral knee.

Postoperatively, active quadriceps exercises starting on the first postoperative day and early mobilization with partial weightbearing using crutches for an average of 3 weeks were encouraged. The postoperative mobilization was supervised by a physiotherapist. The patients returned to the garrison dormitory after a median hospital stay of 5 days (range, 2–8 days) and were closely followed by a physician to ensure they were asymptomatic, had painless weightbearing, and a normal range of motion of the knee before returning to normal military training.

We retrieved and reviewed the original, complete medical records, including radiographs. The followup consisted of a questionnaire including information regarding functional outcome after the excision [17] and a physical examination complemented with anteroposterior, lateral, and tunnel view radiographs of the surgically treated knee. We asked patients about their symptoms and general health status before and after surgery, and possible subsequent operations were recorded. To evaluate functional outcome at followup, we used the Kujala score (0–100) [17]. To determine the degree of subjective pain experienced by the patients at the time of followup, we used a 10-point (0–10 cm) visual analog scale with a score of zero denoting none, 1 to 3 light, 4 to 6 moderate, 7 to 9 hard, and 10 the worst imaginable pain.

The location of the accessory bipartite fragment was categorized from radiographs according to a classification introduced by Erich Saupe in 1921: Type I involving the inferior pole, Type II the lateral margin, and Type III the superolateral quadrant of the patella [25]. Using the tunnel view radiographs, we (MW, MP, HP) measured the patellar angle from a line connecting the anterior aspect of the femoral condyles and a second line along the lateral facet of the patella (Fig. 3A) [18]. Likewise, the sulcus angle was measured from the lines extending from the deepest point of the intercondylar sulcus, medially and laterally, to the tops of the femoral condyles. We then bisected the sulcus angle and this reference line was compared with a line drawn from the apex of the sulcus angle through the lowest point of the articular ridge of the patella (congruence angle) to detect possible lateralization of the patella (Fig. 3B) [20]. On lateral radiographs, we measured the ratio of the patellar tendon length against the greatest length of the patella (Insall-Salvati ratio) to determine the existence of patella alta or patella profunda (Fig. 3C) [12]. The Kellgren-Lawrence scale was used to grade osteoarthrotic changes [16] on the final followup radiographs.

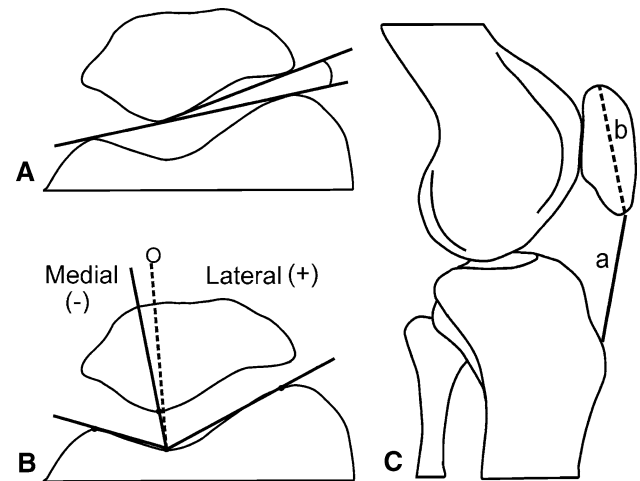


Fig. 3A–C (A) We measured the patellar angle on tunnel view radiographs from a line connecting the anterior aspect of the femoral condyles and a second line along the lateral facet of the patella [18]. (B) The sulcus angle was measured from lines extending from the deepest point of the intercondylar sulcus, medially and laterally, to the tops of the femoral condyles. To detect possible lateralization of the patella, we bisected the sulcus angle and compared it with a line drawn from the apex of the sulcus angle through the lowest point of the articular ridge of the patella (congruence angle) (Adapted from and published with permission from Merchant AC, Mercer RL, Jacobsen RH, Cool CR. Roentgenographic analysis of patellofemoral congruence. *J Bone Joint Surg Am.* 1974;56:1391–1396.). (C) To determine the existence of patella alta or patella profunda, we measured the ratio of the patellar tendon length (a) against the greatest length of the patella (b) (Insall-Salvati ratio) on lateral radiographs.

Mean values were presented in the continuous unskewed data, and median values in the continuous skewed data with range (minimum–maximum). We used SPSS software (version 14.0; SPSS Inc, Chicago, IL) to compute descriptive statistics.

Results

The incidence of painful, surgically treated bipartite or multipartite patella was 9.2 per 100,000 recruits.

The mean Kujala score was 95 points (range, 75–100 points) at final followup after excision of the accessory bipartite fragment. The median visual analog scale score of knee pain at the time of the final followup was 1.0 (range, 0.0–6.0). No reoperations related to the bipartite patella occurred during the followup period. During the immediate postoperative followup, two patients had transient non-bacterial synovitis develop, which subsided after two aspirations, and in one of these patients after an additional intraarticular injection of cortisone. One patient had a superficial wound infection, which subsided within weeks with local treatment and oral antibiotics. After a median of 5 weeks (range, 1–13 weeks) postoperatively, all patients returned to normal military training that consisted of

marching and other physical activities such as running, athletics, games, skiing, and swimming, actively performed on a weekly basis. Three patients reported a later surgical intervention on the same knee for reasons other than the bipartite patella; one patient had arthroscopic revision of patellar chondromalacia (Table 1, Patient 17), one patient underwent diagnostic arthroscopy with no findings, and one patient sustained a knee injury while playing soccer in which the ruptured anterior cruciate ligament was reconstructed with a hamstring tendon graft (Table 1, Patient 16). Based on the functional Kujala scores, all three patients recovered well from the previously mentioned surgical procedures (Table 1, Patients 17, 18, and 16). During the physical examination at the final followup, the range of motion was full and symmetric in all knees, and there were no signs of quadriceps atrophy or instability of the knee. In the patient with the lowest Kujala score (75 points), flexion greater than 90° was painful, and there was some tenderness in the lateral parts of the patella.

At followup in these patients with surgically treated symptomatic bipartite patellae, we uncommonly identified radiographic findings indicating anatomic deviance with the exception of the bipartite lesion. On tunnel view radiographs, the patellar angle opened medially in three knees, indicating the potential for patellar subluxation, whereas in the other 22 knees, the angle was normal (opened laterally). Two knees had a slightly shallow (150°) sulcus angle. One knee had slight lateralization of the patella, but the others were normal. The Insall-Salvati ratio mean was 1.0 (range, 0.8–1.8). Three knees were classified as having patella profunda, and the remaining 22 knees were within the normal Insall-Salvati ratio [12] range (between 0.8–1.2). Nineteen of the 25 fragments (76%) were located at the superolateral part of the patella (Type III; Fig. 1) and six lesions (24%) were lateral (Type II; Fig. 2). None of the excised fragments were located at the inferior pole of the patella (Type I). In 23 patients, the radiographs showed no signs of complications or other adverse development at final followup. Slight formation of osteophytes (Fig. 4) was seen in two knees, primarily patellofemoral. The findings were bilateral, Grade 1 on the Kellgren-Lawrence scale of osteoarthrotic changes [16].

Discussion

A painful bipartite or multipartite patella is a rare condition that mostly resolves after nonoperative treatment. In some cases, however, pain persists despite adequate nonoperative treatment, especially in the adult population, and as surgical excision has been used successfully for pain relief, it is of interest to explore the long-term outcome of this technically undemanding procedure. The main purpose of

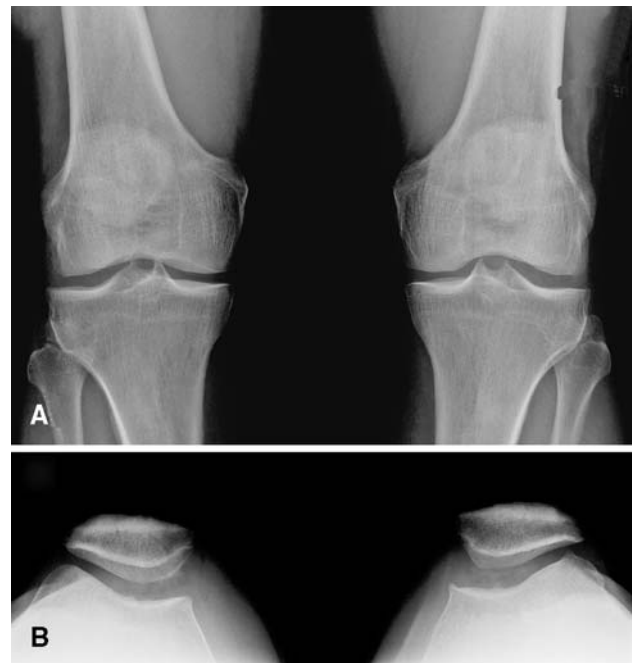


Fig. 4A–B A 20-year-old recruit (Patient 21) presented with knee pain on exertion. Excision of the painful superolateral bipartite fragment was performed in the left knee. At final followup 17 years after excision, (A) anteroposterior and (B) tunnel view radiographs show slight bilateral arthrotic changes.

this study was to determine the incidence of painful bipartite patella in young adult males during military service. Second, we evaluated the long-term outcome after surgical excision of a symptomatic bipartite patella in this group of skeletally mature adults. Finally, we performed a radiographic evaluation of possible anatomic deviations associated with this condition.

One limitation of this study is the retrospective collection method for the primary symptom and surgical data, which offered no tissue samples of the excision area for histologic examination. The patients nevertheless were invited to a final long-term followup including physical examination and radiographs for this study. We present a fairly large group of skeletally mature young adults who underwent uniform treatment according to the policy of one institution. All patients were male recruits, but owing to the compulsory nature of the military service, the subjects represent the general, young adult male population of the country in their age group, unselected for fitness or other specific characteristics. Moreover, the young adult age group of our study is optimal, because this is the age frame in which the bipartite patella is most frequently symptomatic and, as the literature shows, it mostly affects males. Our study offers the longest followup of excision of bipartite patella in a homogenous patient series consisting entirely of skeletally mature young adults, who differ from skeletally immature adolescents in terms of treatment protocol and healing potential.

We found an incidence of unresolved painful bipartite patella of 9.2 per 100,000 recruits. The amount of literature dealing with the existence and surgical excision of bipartite patella in skeletally mature patients is small and consists mainly of case reports [3, 11, 13]. The principal finding of our study was surgical excision of the accessory patellar fragment resulted in excellent or good functional long-term outcome in all but one patient. Postoperative recovery was swift, and no major complications were seen. During the past three decades, surgical excision of painful bipartite patella has been described in some case reports [9, 11, 23], in limited case series including only a few (five to nine) patients [14, 22], and in two studies of comparable size as the current study; one reported favorable outcome for a mixed group of 16 adolescent or adult patients with a followup of 1 year [30], and the other reported complete pain relief for 13 of 16 patients aged approximately 14 years with a 7-year followup [5]. The only previous study focusing solely on adults reported complete pain relief for nine patients, with less than 1-year followup, who underwent excision of a bipartite patella that became painful after injury to the knee [13].

The majority of our patients reported gradual onset of symptoms without specific trauma, and only one third had more sudden, trauma-related onset of symptoms, suggesting the prevailing cause for exacerbation of symptoms was the increased physical exertion level during military service. Preoperative duration of symptoms caused by the painful bipartite patella varied from a few months to several years and were not limited to the military service period. Previous descriptions of painful bipartite patella excision have made a distinction between gradual versus more sudden onset of symptoms after injury to the knee, and good pain relief was reported for both categories [9, 13, 14, 22, 23, 30]. Our results seem to support these opinions.

Based on our data, painful bipartite patella does not seem primarily associated with anatomic deviations. The radiographic findings indicative of anatomic deviance in this study, with the exception of the bipartite lesion, were rare. A few deviations from normal values were seen with respect to lateralization, tilting, or height of the patella, which could predispose to subluxation and thus to breakage of the interfragmentary fibrotic zone. However, these deviations were few and slight and did not provide grounds for important conclusions. Although the literature dealing with bipartite patella mentions the possibility that anatomic deviations might predispose to bipartite patella becoming painful [29], these parameters have not, to our knowledge, been evaluated in previous studies. In the 15-year followup of our study, the osteoarthrotic changes seen were few and unsubstantial, which suggests surgical excision of a symptomatic bipartite fragment does not involve a high

risk of osteoarthrosis, at least in this time frame. Furthermore, one report speculates an untreated symptomatic bipartite patella might predispose to development of osteoarthrosis [14]. In light of this, we presume removal of an accessory fragment would prevent rather than enhance the long-term predisposition to osteoarthrosis. The most common site for the bipartite patella in our patients was the superolateral quadrant, which agrees with earlier reports of outcome after bipartite patella surgery [5, 9, 13, 23, 30]. Moreover, distribution of the location of the bipartite fragment was consistent with prior reports in which superolateral fragments constituted 75%, lateral fragments 20%, and fragments of the inferior pole of the patella 5% [4, 9]. The articular cartilage covering the fibrocartilaginous zone between the patella and the accessory fragment was macroscopically intact at arthroscopy in half of the cases. Some histologic studies [8, 22, 24] note a tendency for an intact articular surface to cover the interfragmentary zone. A previous clinical study reported a linear indentation along the separated area in four of 13 patients at arthroscopic examination before diverse operations to treat painful bipartite patella [22]. However in another report, a ridge separating the accessory fragment was seen at arthroscopy on the articular surface of the patella in all nine cases [13]. The clinical importance of these findings remains as controversial as the etiology of the condition, and our study design does not permit us to draw conclusions regarding this matter.

Unresolved painful bipartite patella is a rare condition and does not seem primarily associated with anatomic deviations, but when incapacitating pain persists despite nonoperative treatment, surgical excision seems to yield excellent to good functional outcome and swift recovery with no apparent tendency of adverse effects in the knee. There appears to be no reason to avoid this technically undemanding procedure for treating unresolved bipartite patella in young adults.

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